**Version With Markings To Show Changes Made**

7. A recuperative heat exchanger as claimed in claim 5 wherein:

[S]said casing is sealed at said top and bottom ends by covering elements.

8. A recuperative heat exchanger as claimed in claim [12] 7 wherein:

[S]said covering elements are formed from a compound which solidifies upon cooling or by chemical reaction.

9. A recuperative heat exchanger for the exchange of heat across a plurality of heat transferring planar elements between a first fluid medium and a second fluid medium, said fluid mediums flowing in opposite directions to each other on opposite sides of said planar elements, said heat exchanger comprising:

a casing for containing a heat transfer package therein, said casing having a top end, a bottom end, a pair of respective lengthwise and widthwise opposed sides, each of said lengthwise sides provided with a pair of inlet and outlet ports, wherein each respective pair of inlet and outlet ports is dedicated to one of said first and second mediums for flow therethrough;

a heat transfer package disposed within said casing, said heat exchange package having a lengthwise extent and a widthwise extent, each of the fluid mediums following on their respective side of the planar elements a net flow path which extends longitudinally along the lengthwise extent, said package comprised of a plurality of generally rectangularly shaped planar elements continuously arranged in sequentially alternating directions in a folded accordion-like manner, each of said planar elements having substantially similar length, width and thickness with respect to each other, each of said planar elements integrally connected to an adjacent planar element along said length, said length and width of said casing substantially corresponding to said length and width of said package, opposing surfaces from each adjacent planar element defining an inter-layer space therebetween for receiving a flow of one of said fluid mediums therebetween, a direction of flow of each medium having a widthwise element and a lengthwise element when flowing within said inter-layer space, each of said planar elements having a corrugated pattern formed therein;

said corrugated pattern extending the entire length and width of each respective

planar element, said pattern corresponding to a series of alternating linear ridges and channels extending across the entire width of each respective planar element, said corrugated pattern interrupted at substantially similar intervals to include a fold line for facilitating arranging each of said planar elements in an accordion-like manner, said fold lines defining said width of each respective element and being disposed parallel of said length of each of said elements, wherein when said heat transfer package is in an unfolded state, a pair of ridges and channels of a first planar element is generally aligned with respect to a pattern of channels and ridges of a successive planar element, and

whereby said flow path has means for creating a flow resistance to said respective mediums such that [a] the flow resistance to [flow of] said respective [flow] mediums flowing over said respective side of said planar elements [such that a resistance to flow of each fluid medium] is greater in said lengthwise direction of said heat transfer package than in said widthwise direction, thereby increasing flow turbulence and heat transfer.

10. A recuperative heat exchanger as claimed in claim 9 wherein:

[S]said casing is sealed at said top and bottom ends by covering elements.

11. A recuperative heat exchanger as claimed in claim 10 wherein:

[S]said covering elements are formed from a compound which solidifies by cooling or by chemical reaction.

**REMARKS**

The Examiner rejected claims 7 - 11 under 35 U.S.C. 112 second paragraph as indefinite. Claims 7, 8, 10 and 11 have been amended as suggested by the Examiner.

The Examiner states that the means plus function recitation in the last paragraph of claim 9 is indefinite. Claim 9 has been amended to remove indefinite language.

The Examiner rejected claims 5 and 7 - 11 under 35 U.S.C. 103(a) as unpatentable over *ACV (SU 800,500)* in view of *Hultgren*. The Examiner admits that *ACV* does not disclose corrugation greater than 45° with respect to the longitudinal flow direction. The Examiner then supplies *Hultgren* as having corrugations which extend at any angle with respect to the net flow path for the purpose of achieving desired flow resistance or pressure drop.

Clearly, *Hultgren* teaches away from the present non-obvious invention. The Examiner previously withdrew *Hultgren* as a reference against the present non-obvious invention (Examiner's Office Action, May 22, 2000) after applicant pointed out how *Hultgren* teaches away from the present non-obvious invention. Arguments originally submitted April 17, 2000 are restated herein below to refresh the Examiner's memory. *Hultgren* states that wave shaped corrugations have no effect with regard to heat exchange between gaseous mediums (column 1, lines 15 - 22). *Hultgren* also states that turbulence must not be created (column 1, lines 40 - 42). The waved-shaped corrugation pattern in the present, non-obvious invention, however has as its object, promoting turbulence (page 7, lines 11 - 16) and lateral dispersion of the flow (page 7, lines 1 - 10). *Hultgren* teaches that efficient gaseous medium heat exchange occurs at the upper edge of laminar flow, and that if turbulence occurs, efficiency drops rapidly. Also, *Hultgren* suggests minimal corrugations which are set at 5 - 20° to the direction of flow (column 3, lines 3 - 9) to prevent turbulence and minimize pressure drop. Contrarily, the present non-obvious invention uses wave-shaped corrugations to induce turbulence and sets them at an angle greater than 45° to the direction of flow to maximize lateral dispersion which maximizes utilization of the heat exchange surface area, thereby maximizing heat exchange transfer (page 7, lines 3 - 16). Therefore, it would not be obvious for one skilled in the art to utilize *Hultgren* and even if one did they would not arrive at the present, non-obvious invention. In addition, as the separating walls of *Hultgren* are spaced apart out of contact with each other, rather than being adjacent to each other to define an interlayer space there between, there is never an

instance where the resistance to flow is greater in the lengthwise direction as compared to the widthwise direction.

The *ACV* reference, resurrected from the former Soviet Union, discloses only a heat exchange apparatus formed from corrugated paper impregnated with thermo-plastic resins. There is no discussion whatsoever of the relevance or configuration of the corrugations other than to create flow channels between adjacent layers of the paper. The paper material used to permit moisture transfer between opposing air flows, having nothing to do with the present, non-obvious invention.

Obviousness cannot be established by combining the teachings of prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination. *ACS Hospital Systems, Inc. v. Montefiori Hospital*, 732 F.2d 1572, 1577, (Fed. Cir. 1984). Absent a showing in the prior art, the Examiner has impermissibly used "hindsight" occasioned by the applicant's teaching to hunt through the prior art with the claimed elements and combine them as claimed. *In re Zurco*, 111 F.3d 887 (Fed. Cir. 1997). *Hultgren* expressly states that turbulence must not be created (column 1, lines 41, 42) and the entire purpose of *ACV* is to permit an intensified transfer of heat and moisture due to cavities for the passage of air having tortuous intersecting channels in which the air flows are turbulent due to the constant direction changes. In addition to hindsight, the Examiner is attempting an improper combination of references where the references teach away from their combination. *In re Grasselli* 713 F.2d 731 (Fed. Cir. 1983).

In view of the Examiner's comments and prior art citations, applicant respectfully submits that the Examiner is missing the thrust of the present non-obvious invention. Heat exchanger design balances the resulting heat transfer with pressure drop. A torturous fluid flow across a heat transfer surface generating higher heat transfer coefficients while at the same time suffering a higher pressure drop which requires extra energy input for circulating the heat transfer mediums. Heat transfer designs balance the extra heat transfer per unit surface area against the cost of the area and the cost and energy requirement for circulating the transfer mediums across the area. This is a basic tenet of heat exchange design and is not at all what the present non-obvious invention is addressing. The present non-obvious invention advances heat exchange theory by focusing on balancing the flows on each side of the heat transfer surfaces. Normal heat exchange theory assumes that all area of the heat transfer surfaces provide an equivalent heat transfer. In reality however the two flows are not evenly spread out across the respective two sides of the heat transfer surface. The two flows are unbalanced resulting in different places of the heat exchange

surface having different surface flows across them resulting in, for example, greater warm flow in a given area as opposed to a greater cooling flow. Even where an extremely large heat transfer surface is available it cannot be assumed that the two flows will be equivalent. The greater of the flows is never fully changed in temperature where the smaller flow will not be able to supply or absorb a sufficient amount of energy. The local imbalances of the flows adversely influence the total heat transfer of the heat exchanger. In heat exchange equipment with similar placement of input and output ports as in the present non-obvious invention there will always be a tendency for the flows on each respective side to pass along the shortest distance. This will result in warm flows concentrating on one side of the bundle and a cool flow concentrating along the opposite side of the bundle. This obviously leads to non-complete heat transfer between two flows.

In the presently cited references, *ACV* and *Hultgren,* this problem is not acknowledged and/or dealt with. The present non-obvious invention's solution to this problem is to provide the heat exchanger surface in a pattern whereby the resistance to flow is greater along the intended direction of flow then it is in the transverse direction. This results in the flow spreading out in the transverse direction which allows for the lowest overall pressure drop as the flow is utilizing all of the available surface and at the same time the spread out flow maximizing the heat transfer as the hot and cold sides of the heat transfer surface have an even distribution of each respective medium. None of the cited prior art in the extensive prosecution of the present non-obvious application has ever suggested, taught or disclosed the importance and the means for distributing the flows evenly on both sides of the heat exchanger surface where the input and output ports for a given heat transfer medium is located on the same edge of the heat transfer bundle. As the prior art fails to teach, suggest or disclose applicants to novel and non-obvious configuration, including having resistance to flow that is greater in the lengthwise direction than in the width direction, rejection under 35 U.S.C. 103(a) is improper.

Having obviated the Examiner's rejections, applicant respectfully requests that a Notice of Allowance be issued without further delay.

Respectfully submitted,

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**CERTIFICATE OF MAILING**

*I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on October 5, 2001.*

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